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A NEW AUTOMATED ON-LINE CONTINUOUS AIRCRAFT TECHNIQUE FOR FORMALDEHYDE MEASUREMENT

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ABSTRACT

A new airborne formaldehyde measurement technique was developed and deployed on board the DOE G1 aircraft during a four-week long 1998 summer ozone study in Phoenix, Arizona. The technique is based on scrubbing gaseous formaldehyde into an aqueous solution containing 2,4-dinitrophenylhydrazine (DNPH) followed by analyzing the hydrazone thus produced using high performance liquid chromatography (HPLC). The aircraft instrument consists mainly of (1) a 28-turn glass coil scrubber, (2) a heated zone maintained at 70˚C to accelerate the DNPH derivatization reaction, (3) an 8-port automatic valve injector equipped with two sample loops, (4) an HPLC system complete with a fast C-18 reverse phase column (1.5 micron, nonporous, 53 x 4.6 mm) and a UV-Vis detector, and (5) a computer for automation and data acquisition. The new fast column employed here in combination with the dual sample loops alternating between filling and injection permitted continuing sampling at a frequency of every 2 min. Chromatographic elution was isocratic at 21% acetonitrile in water. The limit of detection (LOD) is ca. 0.1 part per billion by volume (ppbv) under the typical operating conditions: sample air flow rate = 2.0 L/min, scrubbing solution flow rate = 0.30 mL/min, and a sample injection volume = 0.15 mL. This technique also detects methylglyoxal, although its concentration in Phoenix during our study was nearly invariably below its LOD of 0.08 ppbv. The formaldehyde concentration measured in the boundary layer air over the Phoenix basin ranged from ca. 1 to 4 ppbv, significantly lower than that observed in the densely vegetated Nashville, Tennessee area during the 1995 summer intensive. The sources of formaldehyde and its role in the photochemistry of the arid Phoenix area will be discussed and contrasted with the Nashville observations.